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3. Recent Supplemental Information on Potato Feeding

Introduction

Potato feeding experiments conducted by agricultural experiment stations were reported by Allender in U.S.D.A. Miscellaneous Publication Number 676, "Potatoes for Livestock Feed", October 1948. This report summarizes the results of experiments which have been published since that time. In addition a short discussion of chemical analysis, stressing vitamin and amino acid content, is included.

Beef Cattle

Recent experiments (1) at the University of Minnesota's Northwest Agriculture Experiment Station, at Crookston show that cull and low-grade potatoes can be fed successfully to beef cattle. The experiments were designed to see how successfully raw potatoes could be fed:

- (a) whole with good quality hay,
- (b) chopped with good quality hay, and
- (c) whole with oat straw.

The results of this experiment are given in tables 1 and 2 which are taken from the above mentioned report.

The comparative feeding value of potatoes in different rations was calculated by subtracting the cost of hay and grain fed with potatoes from the cost of hay and grain fed without potatoes, and dividing the difference by the weight of potatoes consumed. The potatoes fed with alfalfa and brome grass hays and grain (lot 2) were worth 39.3 cents per 100 pounds. Sliced potatoes (lot 3) fed with the same ration were worth 24.5 cents per 100 pounds. When oat straw replaced hay (lot 4) the potatoes had a feeding value of 55.8 cents per 100 pounds.

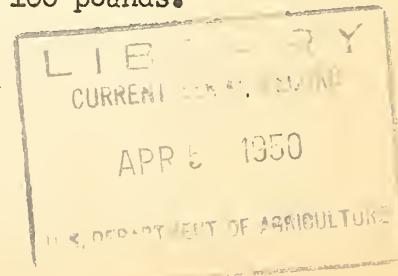


Table 1

Daily Gains, Daily Feed Consumption, Feed per 100 Pounds Gain,
of the Four Lots of Steers in Potato Feeding Experiment

	Lot 1	Lot 2	Lot 3	Lot 4
Average Daily Gain	2.12	2.00	1.72	1.99
Average Daily Feed, Pounds				
Alfalfa Hay	3.0	3.0	3.0	—
Brome Grass Hay	6.53	8.34	9.57	—
Oat Straw	—	—	—	10.70
Potatoes	—	51.49	48.28	52.87
Grain*	16.11	8.68	9.18	8.68
Feed per 100 Pounds Gain				
Alfalfa Hay	141.00	149.48	173.66	—
Brome Grass Hay	307.21	415.77	554.40	—
Oat Straw	—	—	—	537.15
Potatoes	—	2,566.04	2,795.17	2,653.04
Grain	757.38	216.46	265.83	217.86
Cost per 100 Pounds Gain	\$22.17	\$18.48	\$22.21	\$13.97
Net selling price, cwt.	\$24.60	\$24.27	\$24.15	\$24.56
Margin per head over feed cost	\$17.09	\$27.20	\$19.18	\$42.17

Feed prices charged: Barley, \$.90 per bushel; Oats, \$.65 per bushel; Linseed meal, \$80.00 per ton; Alfalfa hay, \$30.00 per ton; Brome grass hay, \$25.00 per ton; Oat straw, \$10.00 per ton; Potatoes, \$.25 per cwt. No charge was made for grinding of grain, slicing potatoes, salt or mineral.

* Grain was fed lot 1 during the entire 168 days and to lots 2, 3, and 4 during the last 54 days only.

Table 2

Selling Price, Dressing Percentages, and Carcass Grades of
the Four Lots of Steers in Potato Feeding Experiment

Price per Hundredweight	Lot 1	Lot 2	Lot 3	Lot 4
	(Number sold)			
\$23.00	1	1	2	—
\$24.25	1	—	—	—
\$24.50	—	3	1	—
\$24.75	—	—	—	4
\$25.25	3	2	3	1
\$26.00	1	—	—	—
Average dressing percent	57.31	57.27	56.55	55.82
Carcass grades				
Choice	2	1	—	1
Good	1	3	3	4
Medium	3	3	3	—

The following conclusions were drawn from this feeding trial:

- "1. A ration of farm-grown feeds with a protein supplement produced satisfactory gains.
- "2. Steers fed grain and good quality roughage were slightly better finished than similar lot fed potatoes and limited grain.
- "3. The steers fed whole potatoes made cheaper gains than the grain-fed steers.
- "4. It is not profitable to slice potatoes for fattening cattle.
- "5. Whole potatoes and a good quality roughage had a feeding value of 39.3 cents per hundredweight. Substituting oat straw for a better quality roughage, the potatoes had a feeding value of 55.8 cents per hundredweight.
- "6. A cheap class of roughage appears to be entirely suitable with a full feed of whole potatoes in rations for fattening cattle.
- "7. The kind of steers fed potatoes in this experiment generally produced satisfactory dressing percentages and carcass grades."

Feeding tests (2) at the Arizona Agricultural Experiment Station indicate that potato meal (sun-dried), when used in palatable and succulent rations, is equivalent in value to barley when fed as a partial replacement of this grain in ratio of sixty parts barley and forty parts potato meal.

Swine

Potato meal is equal to hegari when fed to replace from 30 to 43 percent of this grain in a hog fattening ration. The results of swine fattening experiments (2) at the Arizona Agricultural Experiment Station are summarized in table 3.

Table 3
Potato Meal in a Swine Fattening Ration

	:	Lot 1	:	Lot 2	:	Lot 3
Number of pigs in lot	:	10	:	9	:	10
Number of days on feed	:	90	:	90	:	90
Initial weight per pig (lb.)	:	106	:	107	:	107
Final weight per pig (lb.)	:	233	:	276	:	267
Gain per pig (lb.)	:	127	:	169	:	160
Average daily gain per pig (lb.)	:	1.41	:	1.88	:	1.78
Daily ration (average)	:		:		:	
Hegari	:	5.64	:	4.9	:	3.9
Potato meal	:	--	:	2.15	:	2.9
Meat meal	:	.50	:	.64	:	.6
Cottonseed meal	:	.25	:	.32	:	.3
Alfalfa meal	:	.25	:	.32	:	.3
Total feed	:	6.64	:	8.33	:	8.0
Total feed required per 100 pounds gain	:	471.3	:	445.2	:	449.2
Cost of feed per 100 pounds gain	:	\$11.79	:	\$9.55	:	\$8.98

Poultry

"A feeding experiment has just been concluded on a Long Island duck farm to determine the value of potatoes for ducks. The trial was conducted cooperatively by the Poultry Department of the Cornell University Agricultural Experiment Station, the U. S. Bureau of Animal Industry and the U. S. Bureau of Agricultural and Industrial Chemistry.

"Dehydrated and air-strip dried potato meals were fed. The basal starting ration containing 23-3/4 percent of corn meal and 30 percent of wheat standard middlings was fed for 3 weeks and the grower with 29-3/4 percent of corn meal and 25 percent of wheat standard middlings was fed for 6 weeks. All rations were fed in pellet form.

"There was no effect upon the live weight of the ducks at 9 weeks of age when 20 percent of potato meal was substituted for 20 percent of corn meal, 20 percent of wheat standard middlings or 10 percent of corn meal plus 10 percent of wheat standard middlings. There was some indication that when 30 percent of potato meal replaced 15 percent of corn meal plus 15 percent of wheat middlings, the live weight was slightly reduced. There seemed to be no difference between the two types of potato meal. The average live weight for all of the ducks at 9 weeks was 6.66 pounds with an average feed consumption of 3.48 pounds per pound of duck. Out of two thousand ducklings started in the experiment, nineteen hundred and fifty marketable birds were produced.

"Similar results were obtained in an experiment conducted at Cornell University but with a small number of ducks per pen. In this trial potatoes cooked and mashed were also fed as a supplement beginning the second week. Increasing amounts were consumed up to the 7th week at which time the ducks were being furnished 0.6 pounds of cooked potatoes per duck per day. A total of about 20 pounds of cooked potatoes per duck were consumed during the 9 weeks with a corresponding saving of about 3 - 4 pounds of dry feed per duck." (10)

Zoller fed steamed potatoes to ducks but his ration, which consisted of steamed potatoes 70; cracked oats 15; chopped green feed 15; plus calcium carbonate 5 percent, was low in vitamins and avitaminosis developed. When the potato fraction was reduced to 40 percent and the grain increased to 40 or 50 percent this condition was avoided.

The California Experiment Station has reported results of potato feeding experiments (12) with poult's and chicks.

"The experiments indicate that raw potatoes, when sun-dried or oven-dried, are not a satisfactory feedstuff for growing turkeys or chickens.

"Although dried cooked potatoes caused a slight reduction in growth and feed efficiency of poult's when fed at 40 percent of the ration, it is likely that they can be fed at the 20 percent level which, according to reports from other experiment stations, has proven satisfactory with chickens.

"Unless an inexpensive method of cooking and drying potatoes becomes available it is unlikely that potatoes will ever become a popular feedstuff for poultry."

The results of these experiments are given in table 4.

Table 4

Gains and Feed Efficiency of Poult^s and Chicks fed Rations Containing Potatoes Treated in Various Ways

Group	Potato supplement	Level percent	Poult ^s		Chickens	
			Av. 22 day gain (gms)	Gain per feed consumed	Av. 20 day gain (gms)	Gain per feed consumed
1	None		1096	0.40	447	0.23
2	Sun-dried	20	859	0.31	383	0.19
3	Sun-dried	40	687	0.23	360	0.15
4	Oven-dried, 50°C	40	687	0.22
5	Oven-dried, 85°C	40	588	0.20	364	0.15
6	Cooked, sun-dried	40	915	0.31

Foxes

Cooked potatoes were fed to silver foxes by Petersen (4) but his results were not conclusive as regards either growth or quality of pelt. Experiments (9) at the Bureau of Animal Industry, United States Department of Agriculture Fur Animal Experiment Farm indicate that 50 percent cooked potatoes can be used satisfactorily in fox rations.

Composition

The approximate composition of fresh and dehydrated potatoes is given in table 5. These values have been taken from different sources and are averages.

The amino acid content of potato protein has been reported by Groot (5) and his data are given in table 6. The values are calculated on the basis of 100 percent pure potato protein. Potato protein is deficient in lysine and low in the sulfur containing amino acids. Potatoes should be supplemented with proteins which contain enough of these amino acids to balance the ration. Groot suggested that potatoes be supplemented with casein, muscle protein or even gelatin. In a later paper Groot (6) states that in his earlier work the method used to determine lysine gave low results and that the sulfur containing amino acids are the limiting factors in potato protein.

Table 5

Composition of Fresh and Dehydrated Potatoes

	Fresh Potatoes	Dehydrated Potatoes
Protein	1.5 percent	7.1 percent
Fat	.1 "	.7 "
Carbohydrate	19.1 "	82.0 "
Calcium	50.0 mg./lb.	113.0 mg./lb.
Phosphorus	254.0 " "	467.0 " "
Iron	3.1 " "	16.7 " "
Vitamin A	90.7 i.u./lb.	--
Thiamin	.5 mg./lb.	1.13 mg./lb.
Riboflavin	.18 " "	.45 " "
Niacin	5.4 " "	21.8 " "
Ascorbic acid	77. " "	118.0 " "

Table 6

Amino Acids in Potato Protein

	Percent
Methionine	2.6
Cystine	0.8
Cysteine	0.1
Leucine	9.6
Valine	7.6
Isoleucine	5.
Agrinine	4.8
Histidine	2.2
Lysine	3.6
Threonine	6.9
Phenyl Alanine	5.9
Tryptophan	2.3

Solanine

Rochelmeyer (7) has reviewed the solanine question and states that in addition to solanine, potatoes contain solanidine. Solanine has a stimulating action and solanidine is regarded as the toxic agent. Schierer (8) studied the toxicity of solanine by feeding parts of the potato and by adding solanine to the ration. He concluded that the toxicity of solanine is slight and that it is not to be regarded as a cause of enzootic cardiac arrest in swine.

Digestibility

Woodman and Evans (11) reported studies on the digestibility of potato cossettes and potato meal. Potato cossettes are described as artificially dried finger-like pieces of pulped potato. Data from their paper are given in table 7.

Table 7

Composition and Digestion Coefficients of Potato Cossettes and Potato Meal

	Cossettes	Meal
	Percent	Percent
Dry matter	89.8	90.2
Protein	9.76	10.54
Nitrogen free extract	83.38	82.39
Digestibility of:		
dry matter	80.4*	80.9*
organic matter	81.0	81.4
crude protein	51.0	45.4
Nitrogen - free extract	87.4	88.0
		89.4**
		89.2
		39.9
		96.4

* Test with sheep

** Test with swine

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